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## INTRODUCTION

One of the paradoxes of cultural development in both the New and Old Worlds is the relatively high position of the early human societies of arid lands. These regions which, before our eyes, are, or are rapidly becoming relative "ghost towns" were once the bonanzas of human enterprise. The arid highlands of Peru and Mexico, united with the seasonally dry tropics to furnish the foci of human development in the New World. From these areas came the cultivated plants and the imperfectly domesticated llama and turkey. Peripheral to them lay the more or less independent development of semi-civilized life in Southwestern United States. Utilizing maize, squash, and beans—plants originated far to the South—as the basis of agriculture, there was here developed the most advanced pre-Columbian culture within the boundaries of the United States.

The Puebloan[1] or Anazazi culture founded on agriculture was rivaled only by the Hohokam or Gila Basin culture to the South.

As outlined in Figure 1 the homeland of the Puebloans is bounded on the north by highlands and mountains. The open valleys of these highlands, prized by white men and farmed for hay, oats, and peas, were unat-

[1] "Puebloan," the adjective, is here used in preference to the noun "Pueblo." It includes the development stages of the archaeological sequence and thus includes both "Basketmaker" and "Pueblo."

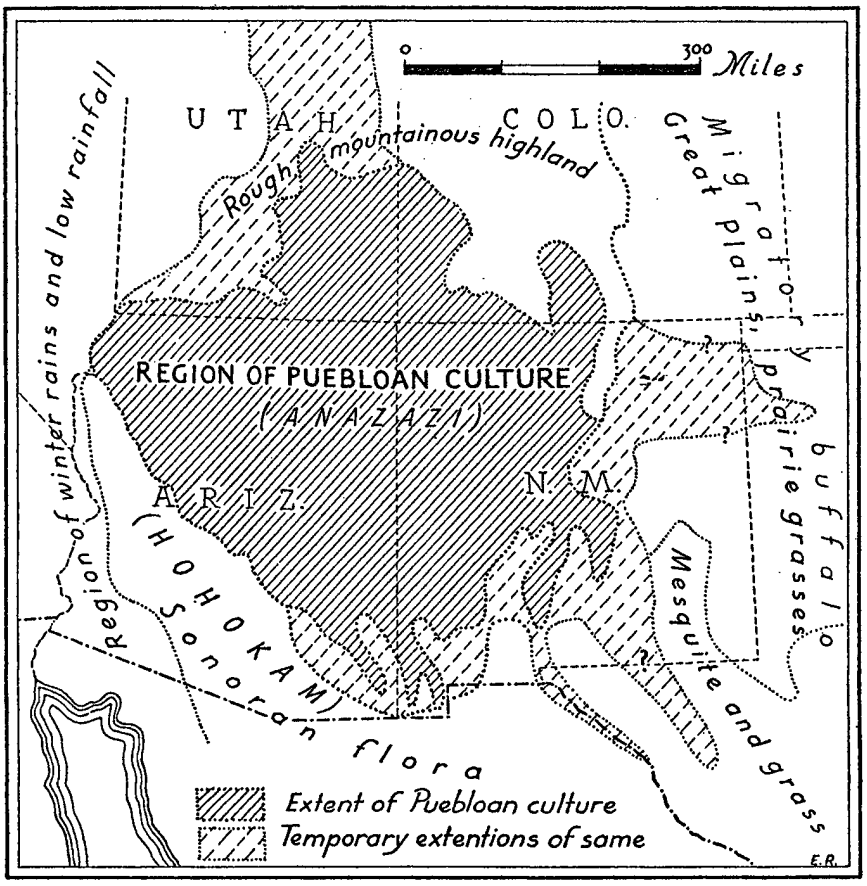


FIG. 1.—The region of Puebloan culture with its natural boundaries. Temporary extensions of the Puebloan culture are indicated.

tractive to primitive agriculturists whose principal crop was corn. In general, areas above 7500 feet in elevation have too short a growing season, and corn does not always mature. Such areas were seldom occupied by the Puebloans. Settlements in such areas appear to have lasted only a short period of years.

To the East the Puebloans were limited by the Great Plains. At various times they thrust settlements into this area, but none persisted for any length of time. This area is suitable for corn growing and actually has a heavier summer rainfall than the Puebloan area. It was, however, the range of the buffalo, whose migration from summer range in the north to winter range in the south was the outstanding characteristic of the area from the stand-

point of primitive man. The tribes that followed the buffalo could easily raid the fields of farmers and were thereby a deterrent to permanent settlement in an area otherwise favorable. When, after the Spanish Conquest, the Plains Indians acquired horses, their raids into the Pueblo Country became much more formidable and led to the abandonment of Pecos in 1838.[2]

To the west the Puebloan area is bounded by the hot deserts of southern Nevada and southeastern California. Not only is the rainfall meagre but a larger proportion falls in the winter. The summer rain necessary for corn is lacking here and in coastal California and was the principal obstacle to the spread of higher civilization westward. The desert tribes lived by hunting and food gathering except for those who fished the Colorado and Gila rivers and planted corn on the wet ground left by the spring floods.

The southern boundary of the Puebloan area corresponds closely to the northern boundary of the Sonoran flora and of the corresponding "mesquite and grass" flora of the Texas area.

The Hohokam lived within the zone of the Sonoran flora which produced a large variety of wild foods to be had for the gathering. Thus an individual or family was free to wander off and eke out a precarious but independent existence without complete reliance on farming or the aid of the farmer. The result was a social organization more diffuse than that of the Puebloan.

Many large groups occupied scattered rancherías of brush huts and lived by transhumance. In summer they planted flood-water fields in localities having only rainwater pools, and in winter they retreated to areas with permanent water. Other large groups built great canals and lived by *irrigation agriculture in the lowlands of the perennial rivers. All, however,* were dependent in large part on the gathering of the relatively abundant food furnished by the Sonoran flora.

To the north, in the cooler zone of the Transition flora, the communal societies of the Puebloan peoples developed. Here the severity of the winter climate and the paucity of wild food inhibited the straying of individuals or families. All were bound to the available tracts of farmable land and to the community.[3] Furthermore, the almost complete absence of June rain and the short growing season increased the hazards of agriculture although the total annual rainfall equals or exceeds that of the Sonoran

[2] Kidder, A. V.: An Introduction to the Study of Southwestern Archaeology, etc., *Phillips Academy, Andover, Southwest Expedition, No. 1,* pp. 14–15 (New Haven) 1924.

[3] Lists of wild plants used by the Puebloans are long, but only the fall harvest of piñon nuts was of large importance in the economy.

Zone. The community with a holdover of corn and beans from the last harvest, was a refuge not lightly deserted. Also each community was separated from the other by lands not only almost barren of wild food but largely depopulated of game by reason of the seasonal hunting of each community. Raids by hunting tribes or by renegades were possible but ineffective against the fortified towns. Long sieges of these towns by people with merely the usual tribal organization and consequent lack of a commissary were infeasible. Thus each community became a unit, safe from outside interference and also from desertion by the seditious. The unity of the community, through time, expressed itself in that almost perfect integration of government, religion, and economic life which we know as the Puebloan culture. In these tightly-knit villages, disruption by individuals became almost impossible, but major schisms doubtless occurred. The founding of new villages may have been preceded by political controversy —party division so severe as to require separation. An example of such a schism is the recent partition of Oraibi to form the new pueblo of Hotevilla in 1906. It is not, however, a perfect homologue as it occurred under the *pax americana.* In pre-Columbian days the fear of other communities and of the hunting tribes must have damped the ardor of seditious parties and restrained schismatics.

The gradual development of the Puebloan culture from humble beginnings to its climax is coming to light. The patient and indefatigable work of a group of archaeologists of outstanding ability has painted for us a picture of this cultural rise.[4] Beginning in a postulated non-agricultural stage[5] known as Basketmaker I, the Puebloans gradually developed into an

[4] For summaries of knowledge of the Puebloans see:

Kidder, A. V.: *op. cit.*

Roberts, Frank H.: *Bur. Amer. Ethnol. Bull. 96,* 1930.

———: Southwestern Archeology, *Amer. Anthrop. n.s.,* vol. 37, pp. 1–35 (Lancaster, Pa.) 1935.

[5] The standard chronology of Puebloan archaeology, dated by the use of the tree ring method of Douglass, is as follows:

| | | |
|---|---|---|
| Pueblo | V | 1600 |
| " | IV | 1300 to 1600 |
| " | III | 1100 to 1300 |
| " | II | 900 to 1100 |
| " | I | 700 to 900 |
| Basketmaker | III | 500 to 700 |
| " | II | ? to 500 |
| " | I | postulated |

Various authorities use slightly different dates, and some question the reality of the boundaries between some of the categories.

agricultural people, and in the stage known as Basketmaker II, lived in groups and practiced many simple arts.

The advance in cultural status was influenced and aided by the development of new varieties of maize better adapted for use as food and hardier under the severe growing conditions of the region.[6] In the Basketmaker III stage, pottery was introduced, shelters were built in caves and in the open. Gradually improvements in the arts occurred, and larger and larger villages were built.

In the San Juan basin, the acme was reached by the end of Pueblo III time, and prosperous and busy communities were then deserted never to be reoccupied (Fig. 2). As much of the earlier archaeological work was done

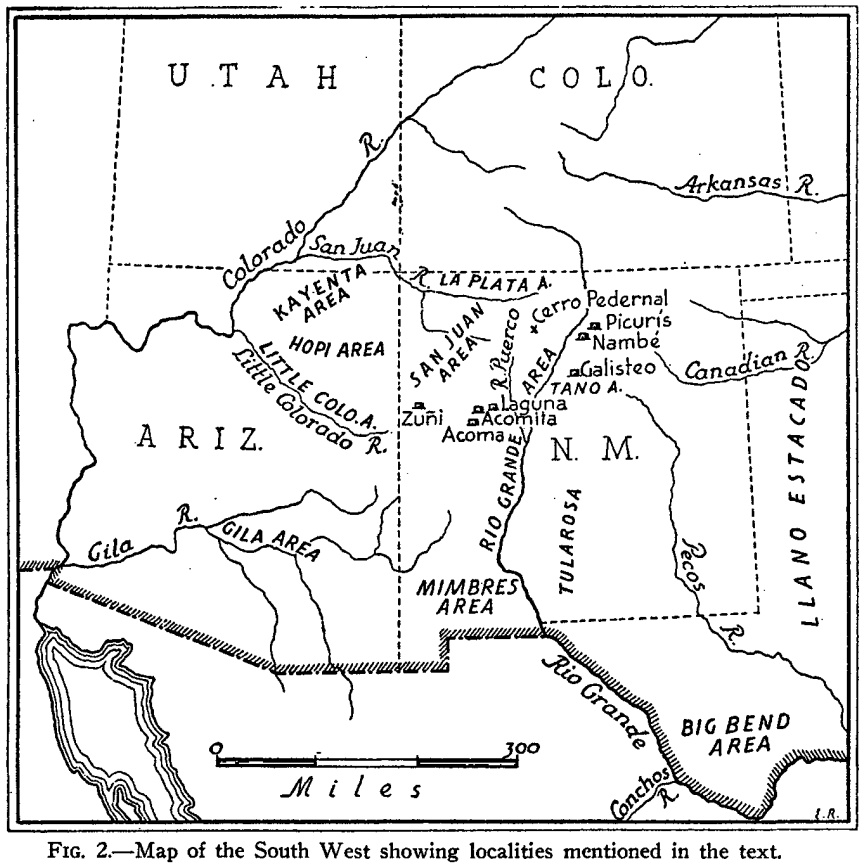


FIG. 2.—Map of the South West showing localities mentioned in the text.

[6] Mangelsdorf, P. C., and R. G. Reeves: The Origin of Indian Corn and Its Relatives, *Tex. Agric. Exper. Statn. Bull. 574*, pp. 256–257, 1939.

in this region, it has been generally held that the desertion of this area marked a great decline in Pueblo culture. More recent work, particularly the excavation of Awatovi[7] in the Hopi country has modified this view. Pueblo IV was a period of growth in culture and in population in the Hopi land. The new people were immigrants displaced from the Kayenta region. Similarly, the Rio Grande and Little Colorado areas, although the evidence is not yet entirely clear, appear to have benefited by the incoming of peoples from the San Juan.

The prime fact seems to be that the cultural changes at the close of Pueblo III time or about 1300 A.D. were the result of migration. Certain areas were deserted, and others received additional population. The human events were in accord with climatic and geologic events, for at this time a great drought occurred and deep arroyos were cut in many streams.

In this paper, the agricultural practices of the Puebloans will be described. The effect on these practices of alternate periods of erosion and alluviation will be discussed. The available information on the correlation of local sequences of erosion and alluviation will be summarized. This material will be analyzed to set forth the relation of these geological events to possible changes in climate, and to geographic changes which affected the distribution of the pre-Columbian agricultural population.

## FLOOD-WATER FARMING

In the Southwest, rainfall is low except at high altitudes where the growing season is too short for corn. Thus agriculture is possible only by the use of specialized methods such as flood-water farming. This system of agriculture has been much described,[8] but its simplicity conceals its importance in the economy of arid lands. The essential feature is the selection for planting of a place overflowed by flood water. The overflow must be sufficient to saturate the ground and thus irrigate the crop and yet not so violent as to wash out the plants. Thus part of the rainfall of a large area is utilized on a small one. The user of this method must have a grasp of

[7] Brew, J. O.: Preliminary Report of Peabody Museum Awatovi Expedition, *Amer. Antiquity*, vol. 5, no. 2, Oct. 1939, pp. 103–114.

[8] Gregory, H. E.: The Navajo Country, etc., *U. S. Geol. Survey, Water-Supply Paper 380*, pp. 102–105, 1916.

Bryan, K.: Flood-Water Farming, *Geog. Rev.*, vol. 19, pp. 444–456, 1929.

Hoover, J. W.: Tusayan—The Hopi Indian Country of Arizona, *Geog. Rev.*, vol. 20, pp. 425–444, 1930.

Forde, Daryll: Hopi Agriculture and Land Ownership, *Royal Anthrop. Inst. Jour.*, vol. 61, p. 357, 1931.

Hack, John T.: The Physical Basis of Hopi Agriculture (Report of the Peabody Museum Awatovi Expedition), *Harvard Univ. Peabody Museum Papers.* [In Press.]

the principles of run-off and stream flow, local knowledge, and skill of a high order.

The physical conditions must also be propitious. Broad valley floors over which the flood run-off after a rain spreads widely are favorable areas. Narrow valleys or large rivers with perennial flow are relatively unfavorable. In the plateau area of northwestern New Mexico, northern Arizona, and southern Utah, the favorable conditions were fulfilled, and this appears to be the original homeland of the Pueblo. Here the silty floods of ephemeral streams spread in the broad alluvium-filled valleys, furnishing ideal sites for flood-water farms.

It is to be presumed that another form of flood irrigation prevailed along the main rivers. As in early Egypt, planting on the moist ground after the spring floods was doubtless practiced. On the Colorado River, the Yuma and nearby peoples may have practiced this method of agriculture, but the less regular floods of the Rio Grande must have made it a relatively hazardous form of agriculture there.

Irrigation with living water is an agricultural method that was also used in the region. By the use of dams and ditches the relatively clear water of perennial streams was led to the fields. This method was well-known to the inhabitants of the Gila region where Haury[9] has proved that ditches were in use from 800 to 1300 A.D. In the Pueblo area such complete evidence has not been gathered. However, one cannot doubt that at Taos, Picurís, Nambé, Jemez and other villages, living water was diverted to the land before the first Spanish exploration by Coronado in 1540 A.D. But in the same general area the villages of the Tano people, Galisteo, San Cristóbal, and others, were located in valleys without perennial streams where flood-water farming must have been the agricultural method. The greatest and some of the earliest centers of the Puebloan cultures—Chaco, Kayenta, and others—were located far from perennial streams. Even today the Hopi, Zuñi,[10] and Acoma[9] farm largely by flood-water methods. The question may be raised whether in the Pueblo area the diversion and use of living water is not a recently acquired trait. Pending the location and excavation of ditches and other irrigation structures definitely tied by archaeological methods to the earlier settlements of the Puebloans, this question cannot be conclusively decided. In a general way, however, it can be stated that by far the greater number of sites and villages of Basketmaker

[9] Haury, E.: The Snaketown Canal: Symposium on Prehistoric Agriculture, *Univ. N. Mex. Bull. no. 296,* Anthrop. Ser. vol. I, no. 5, pp. 48–50, 1936.

Judd, Neil M.: Arizona's Prehistoric Canals, from the Air, *Smithson. Inst. Explor. and Field-Work in 1930,* pp. 157–166, 1931.

[10] Except on lands settled within the past 40 years.